Vacuum Units Conversion

Local application

Mon, Sep 20, 1993

Ion pump power supply currents are used to measure vacuum in the cavities of the Linac upgrade accelerator modules. Vacuum readings in Torr are non-linear with respect to the readings of the ion pump power supply currents. This note describes a simple implementation for support of the non-linear conversion, so that hosts can scale the vacuum readings linearly.

The format of the parameters to specify for this units conversion is as follows:

```
E LOC APPL PARAMS 09/20/93 2129
NODE<0627>  NTRY<12>
NAME=VACT   CNTR=0520
TITL"VACUUM TORR CONVERSION  "
SVAR=00035B22
ENABLE  B<00B2> VACT-2 ENABLE
FORMULA1 <0002>
INPUT1  C<01C2> V1VPAB      V
OUTPUT1 C<0362> V1VTAB      -9T
NCHANS1  <0006>
FORMULA2 <0002>
INPUT2  C<01D0> V4VPAB      V
OUTPUT2 C<0368> V4VTAB      -9T
NCHANS2  <0008>
         <0000>
```

Up to two conversion sets can be specified for each instance of this local application, called VACT. Each specification gives the formula index#, the initial input channel#, the initial output channel#, and the number of sequential channels to be so converted. The output channels are dummy channels whose 16-bit reading words are updated to reflect the results of the calculations. The scale factors for these channels are chosen to suitably fit the expected range of the result with the needed resolution. Since vacuum pressure tends to vary over a wide range, a compromise may need to be made.

In the initial implementation, the scale factors of the dummy channels used to hold the linearized readings are fs=3276.8 and off=3276.8. This gives a range of 0–6553.6 in units of 10^{-9} Torr, or a maximum value of 6.5×10^{-6} Torr. The least bit resolution in the 16-bit word is 10^{-10} Torr.

The formulas used to fit the calibration data for the ion pump power supplies are as follows, where v is the input reading in volts:

Formula index#	*Formula*	*Used for:*

1	If v >= cThr then
	`vacuum:= s*Exp(c10 + v*c11);`
	If v < cThr then
	`vacuum:= s*Exp(c20 + v*(c21 + v*c22));`
		one 230 l/sec ion pump

2 If v >= dThr then two 230 l/sec ion pumps

```
vacuum:= s*Exp(d10 + v*d11);
```

If v < dThr then

```
vacuum:= s*Exp(d20 + v*(d21 + v*d22));
```

3 30 l/sec ion pump

```
vacuum:= s*Exp(t10 + v*t11) + Exp(t20 + v*t21);
```

Units of vacuum are 10^{-9} Torr, so s=1.0E9.
Coefficients used initially in the program are as follows:

```
cThr= 3.1; c10=–10.568; c11=–1.429; c20=10.972; c21=–14.797; c22=2.070;

dThr= 3.2; d10=–11.313; d11=–1.405; d20=–9.432; d21=–0.118; d22= 0.577;

t11= –1.535; t10= 5.09*t11; t21= –38.4; t20= –2.38*t21;
```

Of course, additional formula indexes can be defined using more constants by changing the local application source code.

In the initial implementation, readings are updated at 15 Hz. For 16 channels of conversion of 230 l/sec ion pumps, about 2.5 ms are required for the 68020-based local stations. Since these are vacuum readings, a more leisurely update rate could be adopted to save time. Also, since the vacuum signals from node 627 are also wired to the individual klystron stations in nodes 620–626, each station could run its own copy of VACT to spread the computing load.

The source code is 250 lines of Pascal, executing in 7K bytes.